Space Weather Technical Forecast

Issued on Friday, 04 November 2022 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storms through day 1 and overnight into day 2 (4/5th November).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours. The six active regions on the disk are largely magnetically simple, stable and relatively inactive. In the northeastern disk AR3137 has seen an increase in magnetic complexity so is now analysed as Beta-Gamma/ Cai, and a NEW region continues to emerging around the NE limb, this region analysed as a large single spot though the current position on the limb makes precise categorising difficult. No significant Earth directed CMEs have been identified, though we await model data from a slow CME analysed as emanating from AR3116 near centre disk around 03/0730UTC.

Solar Wind / Geomagnetic Activity: The solar wind, observed by ACE/DSCOVR at L1, has been slightly-elevated for much of the period, averaging between 450-500 km/s, but have seen a steady increase from around 03/1400UTC to become Elevated averaging around 550-600km/s with a peak value recorded by DSCOVER of 638km/s at 03/2023UTC. Density was mainly average. Total magnetic field strength was predominantly moderate around 9nT. The north-south component, Bz, has largely negative, averaging around -5nT for much of the period with a dip to -9nT briefly around 03/1500UTC. Phi angle was mainly positive (Away from the Sun) with only brief transitions into the negative sector. Geomagnetic activity was Quiet (Kp0-2) to start but increased to unsettled to Active (Kp3-4) with a Minor Storm (G1/Kp5) during the UTC afternoon.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has been at moderate or high levels, with a peak of 2.80e3 at 03/1300 UTC. Electron fluence levels had increased above the Active threshold but are now on a declining trend. 4.9e7 integrated pfu was observed at 04/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low with a slight chance of isolated Moderate activity, particularly as further active regions are due to rotate onto the visible disc by the end of the period.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are currently forecast. Earth is currently connected to the high speed stream from coronal hole 39, with wind speeds currently averaging around 550-600km/s. This combined with generally negative Bz values likely giving Isolated G1/Minor Storms intervals during the early hours of day 1 (4th). Geomagnetic activity is forecast to ease somewhat through day 1 (4th) to mainly Unsettled, with a likelihood of further Active intervals and a chance of further G1/Minor Storm intervals overnight into day 2 (5th). Activity should ease back to mainly Quiet to Unsettled from later day 2 (5th) as the earth looks to leave this current high speed stream.

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Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2 MeV) observed by GOES-16 is forecast to remain at moderate to high levels through the period. The associated 24 hour electron fluence is currently below the Active (1e8 integrated pfu) threshold but is expected to rise later in the period as Geomagnetic activity reduces.

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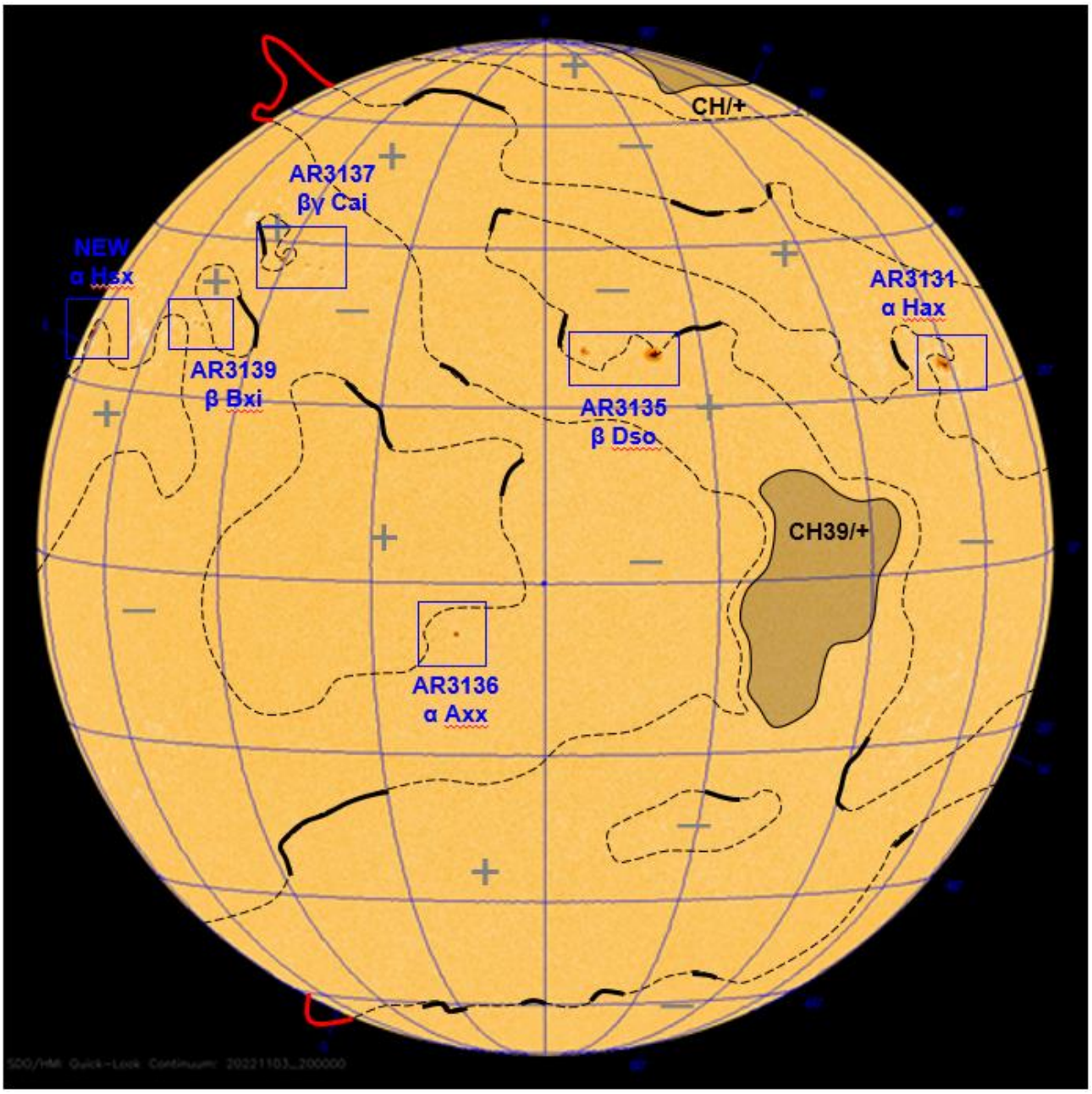
Figure 1. Solar Analysis Valid 03/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth directed CMEs are currently forecast, though we await model data from a slow CME analysed as emanating from AR3116 near centre disk around 03/0730UTC, though this not expected to be significant.

Earth is currently connected to the high speed stream from coronal hole 39, with wind speeds currently averaging around 550-600km/s and locally as high as 630km/s. This combined with generally negative Bz values likely giving Isolated G1/Minor Storms intervals during the early hours of day 1 (4th). Geomagnetic activity is forecast to ease somewhat through day 1 (4th) to mainly Unsettled, with a likelihood of further Active intervals and a chance of further G1/Minor Storm intervals overnight into day 2 (5th), though by this time STEREO A data suggest Bz values will be more neutral. Activity should ease back to mainly Quiet to Unsettled from later day 2 (5th) as the earth looks to leave this current high speed stream.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	40	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

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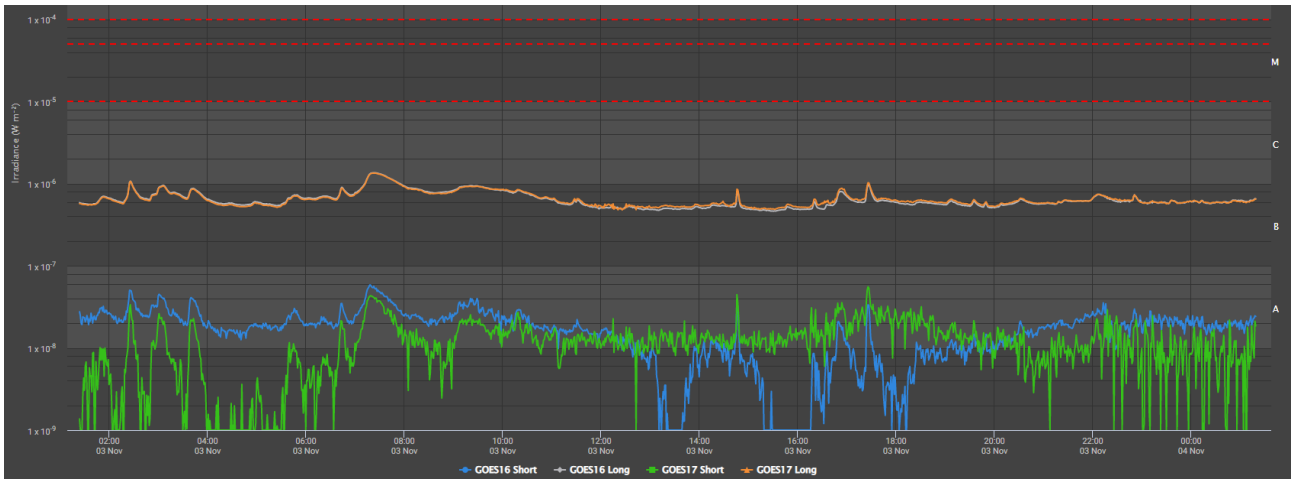
Radio Blackouts - X-Ray Flares:
There are six sunspot regions on the visible disc. Those in the central and western disk all remain relatively simple and mature. In the northeastern disk AR3137 has developed further leader spots and some increase in magnetic complexity so is now analysed as Beta-Gamma/ Cai. The NEW region continues to emerging around the NE limb, this region analysed as a large single spot though the current position on the limb makes precise categorising difficult.

Solar activity is expected to remain Low with isolated low energy C-class flares. A further recurrent and potentially active sunspot region is expected to rotate onto the visible disc by day 4 however, causing an increase in the flare risk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: Current X-Ray flares



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background and is forecast to remain at this level through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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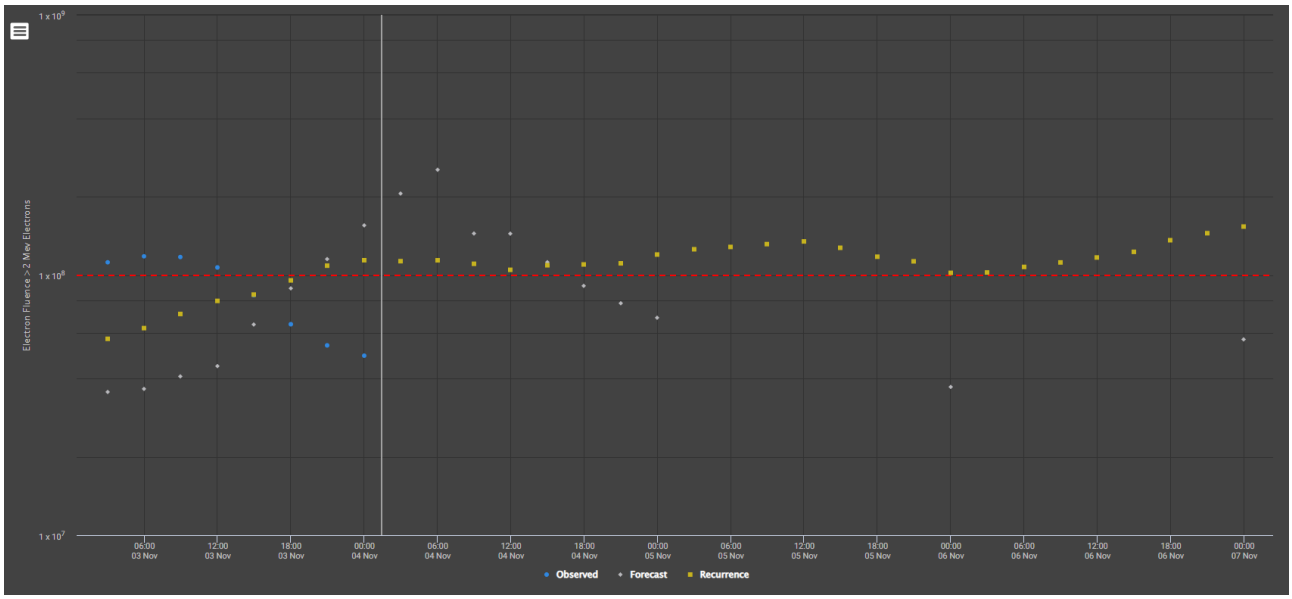
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) is currently oscillating through moderate to high levels on a diurnal cycle. This pattern is expected to continue through the period, based on electron belt models with the radiation belts receiving a feed of electrons from the recent high speed streams. There is a chance that the ongoing high speed stream could be strong enough at times to distort the belts out of their natural orbits and lead to a dip in the flux, with a sharp recovery as the belts relax later in the period as the potential strong solar wind eases.

The 24 hour electron fluence is currently below the Active (1e8 integrated pfu) threshold but is expected to rise later in the period as geomagnetic activity reduces and electron flux remains at moderate to high levels.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	30	40	50	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: Current REFM model below. Note this is currently giving poor guidance with current values suppresed due to ongoing geomagnetic activity.



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